



ME-SBC™

Smart Battery Combiner™



Owner's Manual

Disclaimer of Liability

Since the use of this manual and the conditions or methods of installation, operation, and maintenance of the ME-SBC™ are beyond the control of Magnum Energy Inc., this company does not assume responsibility and expressly disclaims liability for loss, damage or expense, whether direct, indirect, consequential or incidental, arising out of or anyway connected with such installation, operation, use, or maintenance.

Due to continuous improvements and product updates, the images shown in this manual may not exactly match the unit purchased.

Restrictions on Use

The ME-SBC™ shall not be used in connection with life support systems, life saving or other medical equipment or devices. Use of the ME-SBC™ with this particular equipment is at your own risk.

IMPORTANT PRODUCT SAFETY INSTRUCTIONS

This manual contains important safety instructions that must be followed during the installation and operation of this product. Read all instructions and safety information contained in this manual before installing or using this product.



WARNINGS:

- All electrical work must be performed in accordance with local, state and federal electrical codes.
- This product is designed for indoor / compartment installation. It must not be exposed to rain, snow, moisture or liquids of any type.
- Use insulated tools to reduce the chance of electrical shock or accidental short circuits.
- Remove all jewelry such as rings, watches, bracelets, etc., when installing or performing maintenance on the ME-SBC™ system.
- Always disconnect the batteries or energy source prior to installing or performing maintenance on the ME-SBC™ system.

Safety Symbols

To reduce the risk of electrical shock, fire, or other safety hazard, the following safety symbols have been placed throughout this manual to indicate dangerous and important safety instructions.



WARNING: This symbol indicates that failure to take a specified action could result in physical harm to the user.



CAUTION: This symbol indicates that failure to take a specified action could result in damage to the equipment.



Info: This symbol indicates information that emphasizes or supplements important points of the main text.

List of Sections

1.0 Introduction	1
2.0 Installation.....	3
3.0 Adjusting the ME-SBC™	11
4.0 Limitations of Throughput	12
5.0 LED Indicators.....	13
6.0 Troubleshooting	14
7.0 Specifications	15
8.0 Limited Warranty	16

List of Tables

Table 2-4, Recommended Wires Sizes for 3% loss	5
Table 3-2, Battery Combining Operation.....	12
Table 5-1, LED Indicators	13
Table 6-1, Troubleshooting Table	14
Table 7-1, Specifications	15

List of Figures

Figure 1-1, Front Panel Interface	2
Figure 2-1, ME-SBC™ Dimensions	3
Figure 2-2, Power Terminal Block.....	4
Figure 2-3, Accessories Terminal Block	4
Figure 2-5, ME-SBC™ - 25 Amp Combiner Mode.....	6
Figure 2-6, Solenoid Drive	8
Figure 2-7, Remote Volt Sense	10
Figure 3-1, Battery Combining Setpoints.....	11
Figure 3-2, Battery Combining Operation	12

Introduction

1.0 Introduction

The Magnum Smart Battery Combiner™ (ME-SBC™) is designed to monitor and charge a second battery using a portion of the current that is charging a main battery.

The ME-SBC™ uses MOSFETs, which is a bidirectional electronic switch, control circuit that eliminates a significant voltage drop and provides automatic turn on and off based on adjustable voltage setpoints; allowing different batteries to be charged from a single charging source and preventing over or under charging.

1.1 Product Features

- Compatible with 12 or 24 volt Systems
- Very easy install and setup
- Auto-detecting input voltage (12, 24V)
- Transfers up to 25 Amps
- Solenoid drive for ampacity requirement greater than 25 Amps
- Over-temp shutdown
- Wide voltage range allows maximum charging flexibility
- Adjustable Voltage settings
- Over-current shutdown
- Front panel LED's for status and troubleshooting
- Reverse polarity protection
- Virtually zero voltage loss
- Bidirectional charging
- Sense lead for long run applications

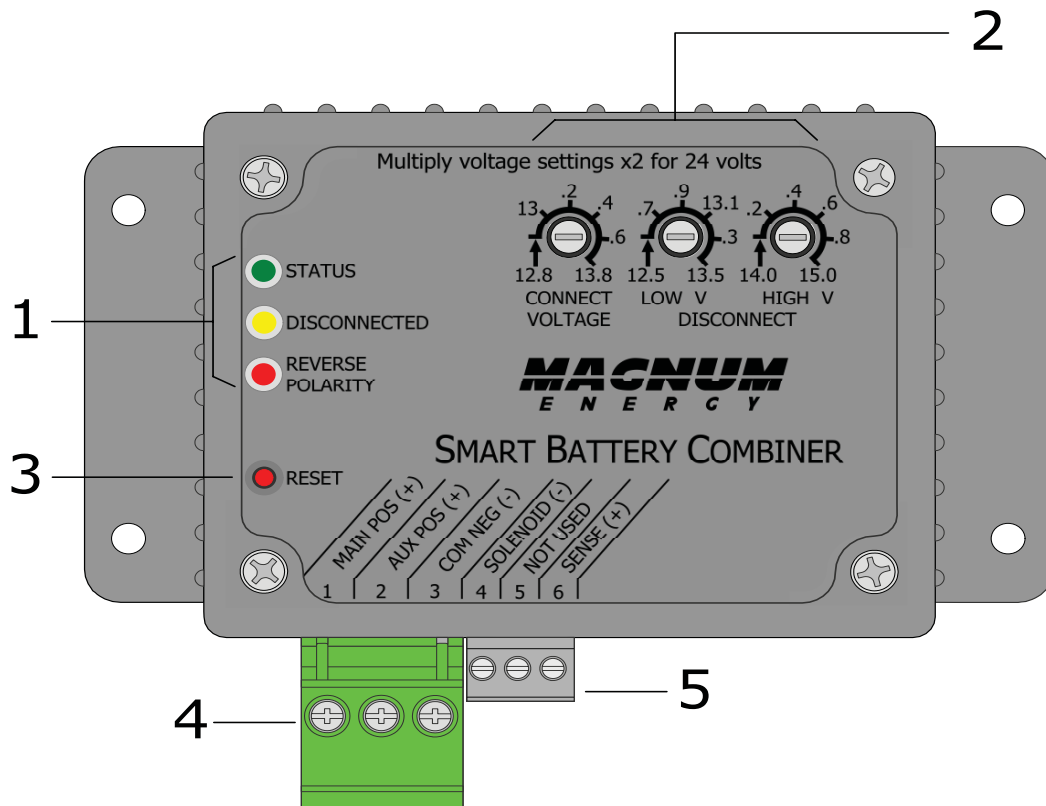


Figure 1-1, Front Panel Interface

1.2 Front Panel

1. **LED Indicators** - The at-a-glance LEDs provide status and operation in a straightforward way.
2. **Adjustable Voltage Settings** - Three dials for adjusting the CONNECT VOLTS DC and the LOW and HIGH VDC DISCONNECT settings for maximum charging flexibility.
3. **Reset Switch** - Performs a full reset of the ME-SBC™.
4. **Power Terminal Block** - The oversized, removable terminal block allows fast and easy wire connections from the battery banks and makes provision for large wires to accommodate for long wire runs.
5. **Accessories Terminal Block** - Easy wire terminal block adds functionality to drive a solenoid, or run a separate *Remote Voltage Sense* line to compensate for systems with long wire runs.

Installation

2.0 Installation

Before installing the ME-SBC™, read this entire section to be aware of all aspects of the installation; then you can thoroughly plan the details to ensure the overall system requirements are accomplished.

To assist you in planning and designing your installation; you should review the basic system diagram shown in Figure 2-2 and Figure 2-3.



Info: Installations should be performed by qualified personnel, such as a licensed or certified electrician. It is the installer's responsibility to determine which safety codes apply and to ensure that all applicable installation requirements are followed.



Info: Review the "Important Product Safety Information" on the front inside cover page before any installation.

2.2 Location and Mounting

Select a location that is dry and away from extreme temperatures to mount the ME-SBC™; using the supplied #8 x 3/4 screws (x4). Allow ample room to access the three adjustment dials, to view the LEDs and to access the terminal blocks; refer to Figure 2-1 for dimensions on the ME-SBC™.



CAUTION: Do not mount the ME-SBC™ in a closed battery compartment or in an area where water or any other liquid can enter the ME-SBC™ and cause shorting or corrosion. The internal circuit board is conformal coated to help prevent corrosion. However, a failure that is caused by corrosion is not covered by the warranty.



WARNING: This device is not tested for Ignition Protection. Do not install this device in a gasoline engine room or any other area that requires an ignition protection rating.

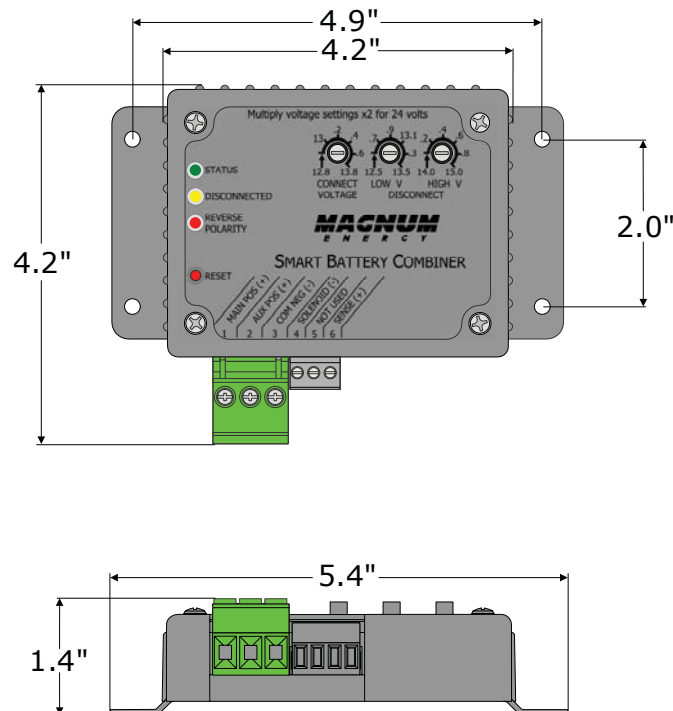


Figure 2-1, ME-SBC™ Dimensions

2.3 Connections

Please refer to the diagrams below for connectivity information.

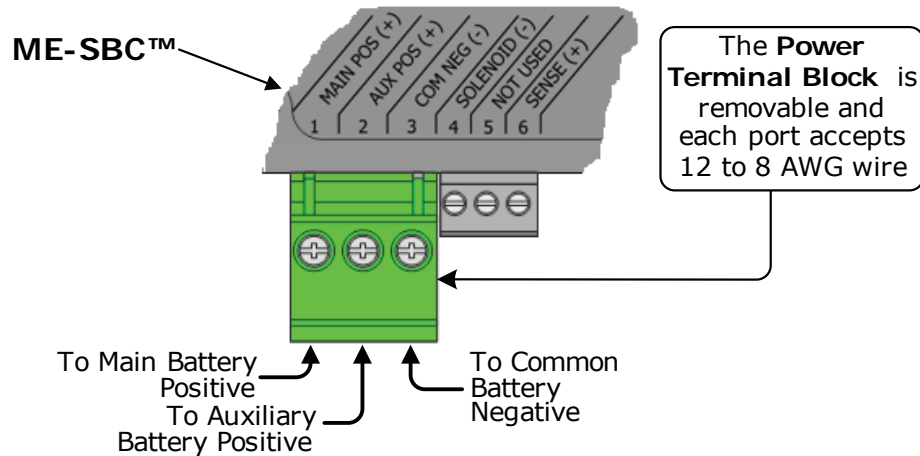


Figure 2-2, Power Terminal Block

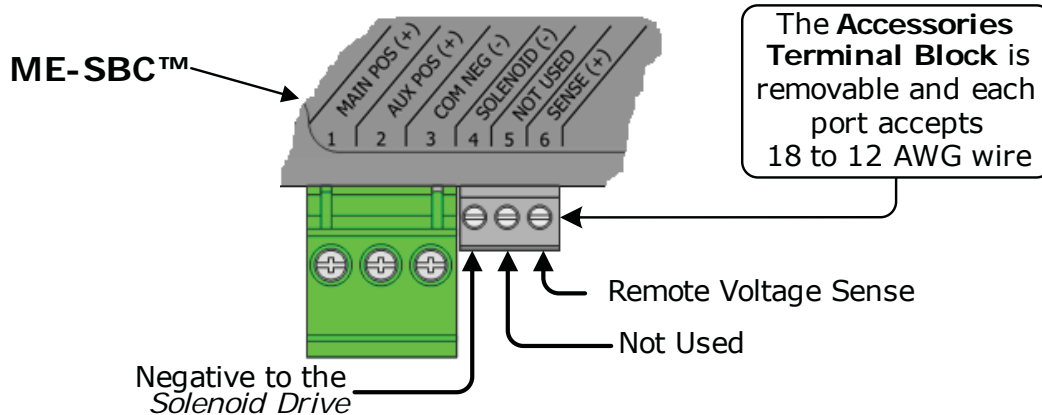


Figure 2-3, Accessories Terminal Block

2.4 Configurations

The ME-SBC™ can be configured to accomplish battery combining in a simple, flexible way. There are two methods and they are as follows:

25 Amp Combiner - This configuration is simple to install and use. The 3-wire connection system is similar to connection methods used by other battery combining products. One of the the advantages of this controller is the advanced combining options that are available to the installer. It is best to choose this method when designing systems where 25 amps or less are required. For this configuration see **Figure 2-5**.

Solenoid Drive - If more battery combining capacity (or Ampacity) is required the installer can employ any solenoid, so long as the coil of that solenoid consumes less than 2 Amps. The source that provides power to the solenoid must not exceed 40 VDC. This circuit switches DC Negative to the accessory terminal block position #4 entitled **Solenoid (-)**. For this configuration please see **Figure 2-6**.

Installation

2.4.1 ME-SBC™ Wiring Connections - 25 Amp



CAUTION: Before connecting any wires, turn off any battery charger and loads that are connected to the battery banks that the ME-SBC™ will be combining.



Info: If installing in a boat, RV or truck, ensure the conductors passing through walls, bulkheads or other structural members are protected to minimize insulation damage such as chafing; which can be caused by vibration or constant rubbing.

The ME-SBC™ should now be mounted if not please refer to **section 2.2**. During installation please refer to **Figures 2-5** during the following steps:

1. Unplug the **Power Terminal Block** from ME-SBC™ and ensure the openings are unscrewed enough to allow the wires to be inserted.
2. Select and connect an appropriately sized red wire¹ from terminal **#1 - MAIN POS (+)** on the **Power Terminal Block** to the positive terminal of the **Main Battery**.
3. Select and Connect an appropriately sized red wire with a white stripe¹ from terminal **#2 - AUX POS (+)** on the **Power Terminal Block** to the positive terminal of the **Auxiliary Battery**.
4. Select and connect an appropriately sized a black wire¹ from terminal **#3 - COM NEG (-)** on the **Power Terminal Block** to the **Negative bus-bar** or vehicle chassis.



Info: The **Negative busbar** must connect the negative terminals on the **Main and Auxiliary Batteries** together.

5. When all the connections are made and checked, plug the **Power Terminal Block** into the ME-SBC™ to supply DC power.



Info: If there is a miswire in the system the "Reverse Polarity" LED will be on. Correct the polarity of the wires connected to the **Main Terminal**.

6. Immediately after applying DC power, the LED's on the ME-SBC™ should come on as the unit goes through a power-up self-test. After the initial self-test completes, the *Status* LED should be illuminated. If so, your ME-SBC™ is now ready for set-up; if not, please refer to the troubleshooting section.

	10 ft	15 ft	20 ft	30 ft
12 V	10 AWG	8 AWG	not recommended	not recommended
24 V	12 AWG	12 AWG	10 AWG	8 AWG

Table 2-4, Recommended Wires Sizes for 3% loss

note 1 : The wires connected to **#1 - MAIN POS (+)**, **#2 - AUX POS (+)** and **#3 - COM NEG (-)** should be sized for 30 amps and the same size. The battery positive **#1 - MAIN POS (+)** and **#2 - AUX POS (+)** lines should be protected with a 30 Amp fast blow fuse. Wire size should be appropriate for the application.

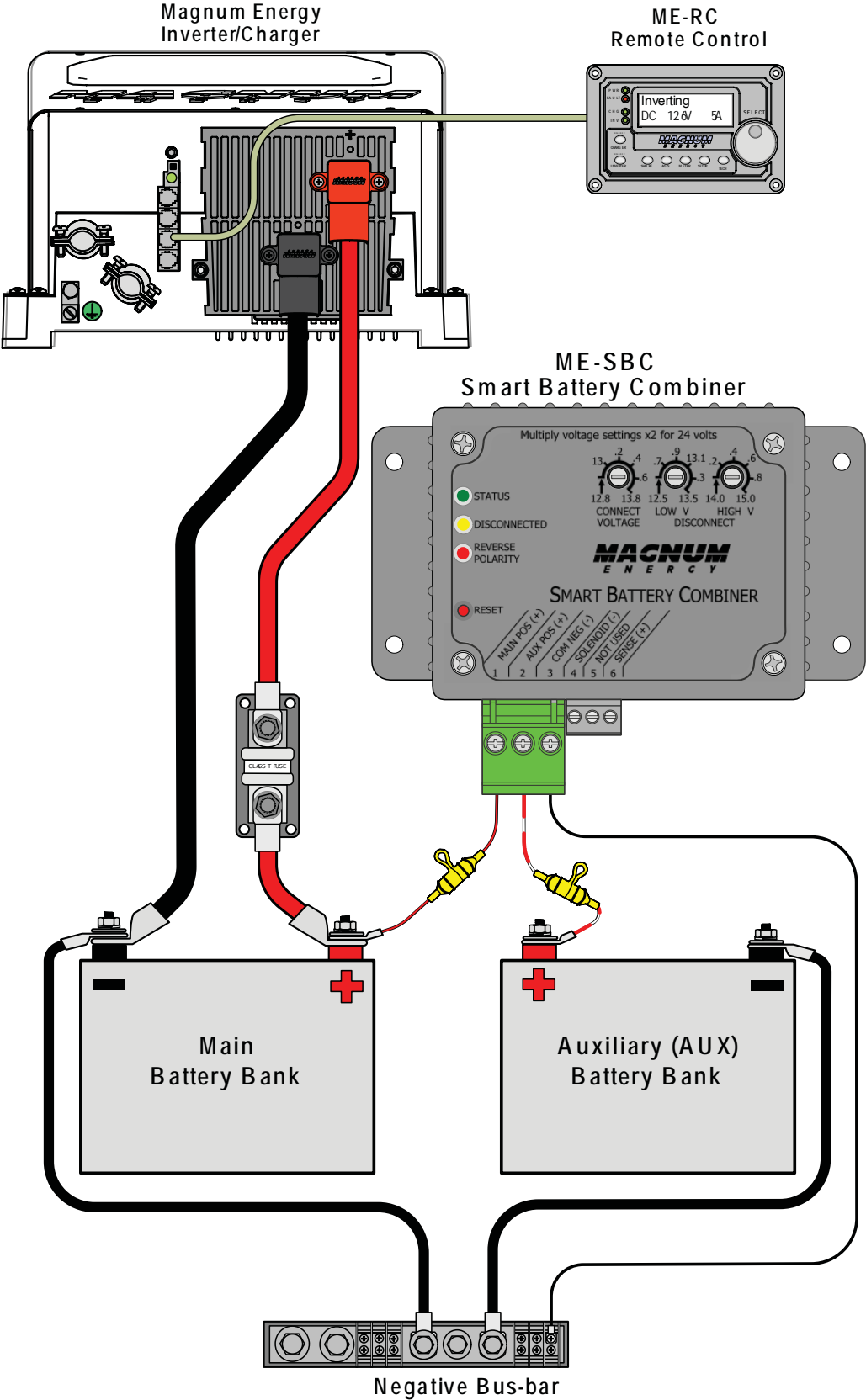


Figure 2-5, ME-SBC - 25 Amp Combiner Mode

Installation

2.4.2 ME-SBC™ Wiring Connections - Solenoid Drive



CAUTION: Before connecting any wires, turn off any battery charger and loads that are connected to the battery banks that the ME-SBC™ will be combining.



Info: If installing in a boat, RV or truck, ensure the conductors passing through walls, bulkheads or other structural members are protected to minimize insulation damage such as chafing; which can be caused by vibration or constant rubbing.

The ME-SBC™ should now be mounted, if not please refer to **section 2.2**. During installation please refer to **Figures 2-6** during the following steps:

1. Unplug the **Power Terminal Block** from ME-SBC™ and ensure the openings are unscrewed enough to allow the wires to be inserted.
2. Select and connect an appropriately sized red wire¹ from terminal **#1 - MAIN POS (+)** on the **Power Terminal Block** to the positive terminal of the **Main Battery**.
3. Select and connect an appropriately sized red with white stripe wire¹ from terminal **#2 - AUX POS (+)** on the **Power Terminal Block** to the positive terminal of the **Auxiliary Battery**.
4. Select and connect an appropriately sized black wire¹ from terminal **#3 - COM NEG (-)** on the **Power Terminal Block** to the negative busbar or vehicle chassis.



Info: The negative busbar must connect the negative terminals on the **Main and Auxiliary Batteries** together.

5. Use an appropriately sized wire² to connect each terminal of the solenoid to the appropriate battery terminal. Please refer to **Figure 2-4** for more information
6. Connect one side of the solenoid coil to a positive post on the **Main or Auxiliary Battery** or one of the main terminal on the solenoid. Use the appropriate fuse to protect the wire (2 Amp fast blow maximum). For more information, please consult the solenoid manufacturers installation instructions.
7. Connect the other side of the solenoid coil to **# 4 - SOLENOID (-)** on the **Accessories Terminal Block**.
8. When all the connections are made and checked, plug the **Power Terminal Block** into the ME-SBC™ to supply DC power.
9. Immediately after applying DC power, the LED's on the ME-SBC™ should come on as the unit goes through a power-up self-test. After the initial self-test completes, the *Status LED* should be Illuminated. If not, please refer to the troubleshooting section.

note 1 : The wires connected to **#1 - MAIN POS (+)**, **#2 - AUX POS (+)** and **#3 - COM NEG (-)** should be sized for 30 amp. The battery positive lines should be protected with a 30 Amp fast blow fuse. Wire size should be appropriate for the application.

note 2 : The size of this wire will likely be determined by considering the 3% voltage drop requirements of the charging circuit. Always consult the solenoid manufacturers installation documentation.

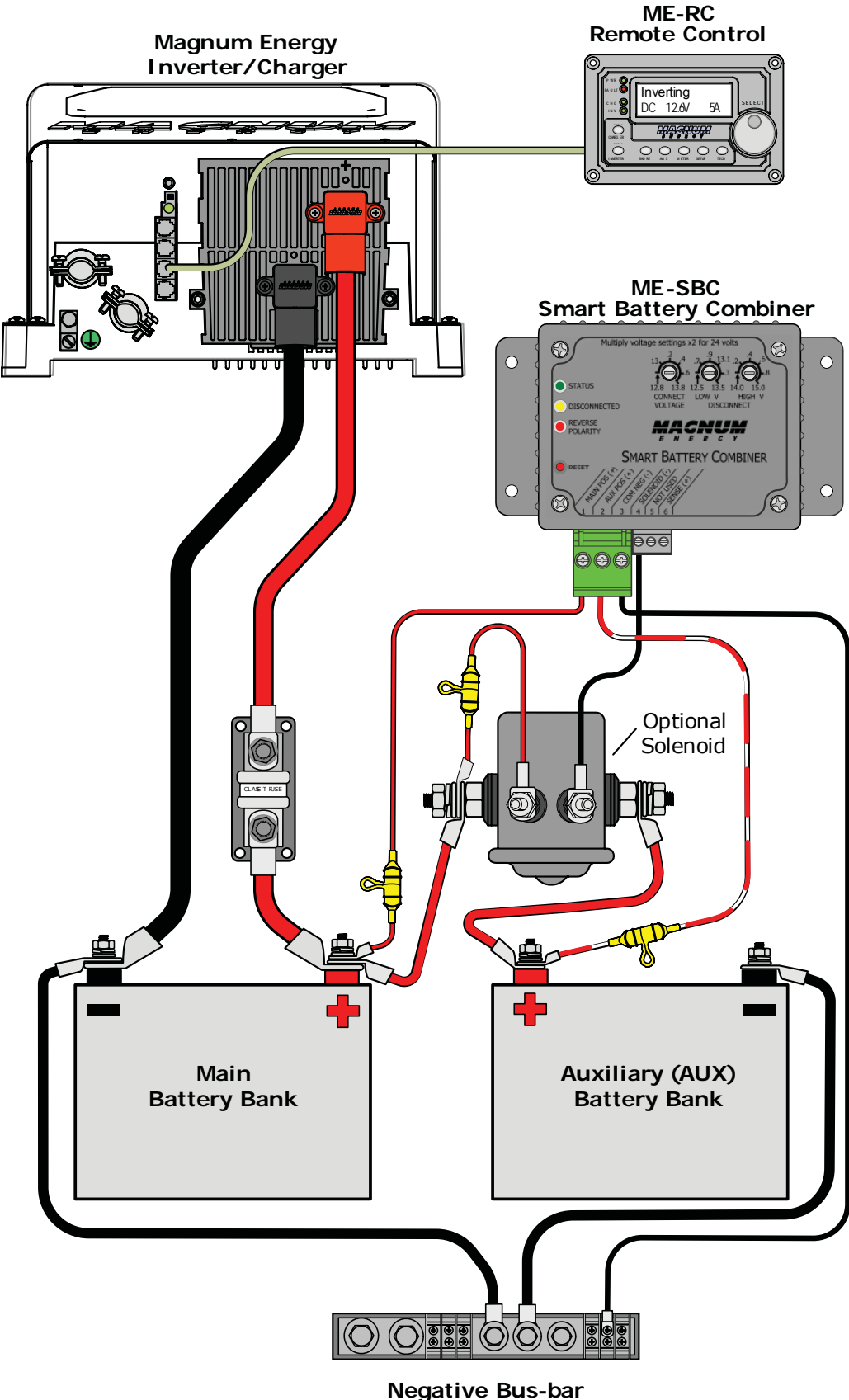


Figure 2-6, Solenoid Drive

Installation

2.4.3 ME-SBC™ Wiring - Remote Volt Sense

The *Remote Volt Sense Wire*, or the wire connected to **#6 - SENSE (+)**, can be used to better sense when the batteries are being charged. As the ME-SBC™ combines the **Main and Auxiliary Batteries**, the current path distributes voltage drops throughout the circuit that may cause the ME-SBC™ to cycle unnecessarily. The *Remote Volt Sense Wire*, if utilized, tells the ME-SBC™ what the actual voltage is by bypassing the current path and therefore the voltage drops. The *Remote Volt Sense Wire* can be connected at the battery or at the charging source (i.e. Alternator, Solar, Wind, etc).



CAUTION: Before connecting any wires, turn off any connected battery charger and ensure all negative and positive battery cables are disconnected from the battery bank.



Info: If installing in a boat, RV or truck, ensure the conductors passing through walls, bulkheads or other structural members are protected to minimize insulation damage such as chafing; which can be caused by vibration or constant rubbing.

1. Install and connect the ME-SBC™ as indicated in **Section 2.2.2** or **Section 2.2.3**

2. **Remote Volt Sense Wire:** Install a minimum of an 18 AWG wire between the **Main Battery** positive and the **#6 - SENSE (+)** on the accessories terminal on the ME-SBC™. The *Remote Volt Sense Wire* should be fused at 0.25 Amps with a fast blow fuse.



Info: Connect the highest current cable directly to the battery terminal, and in descending order in terms of ampacity, connect the rest of the cables. The *Remote Volt Sense Wire* should be the last connection on the battery. For a detail of this information, please see the **Main Battery** positive post in **Figure 2-7**.

Installation

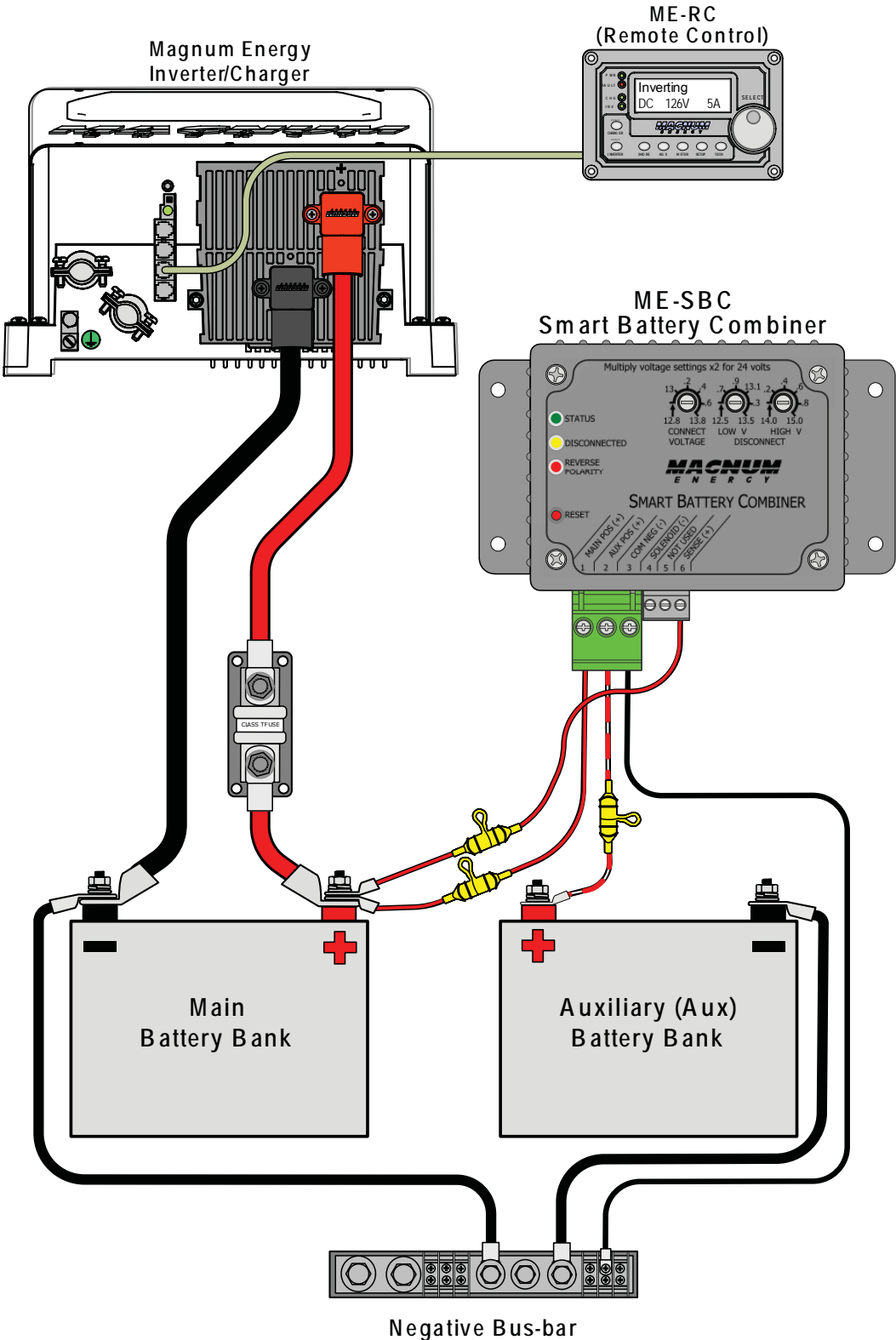


Figure 2-7, Remote Volt Sense

Setup

3.0 Adjusting the ME-SBC™

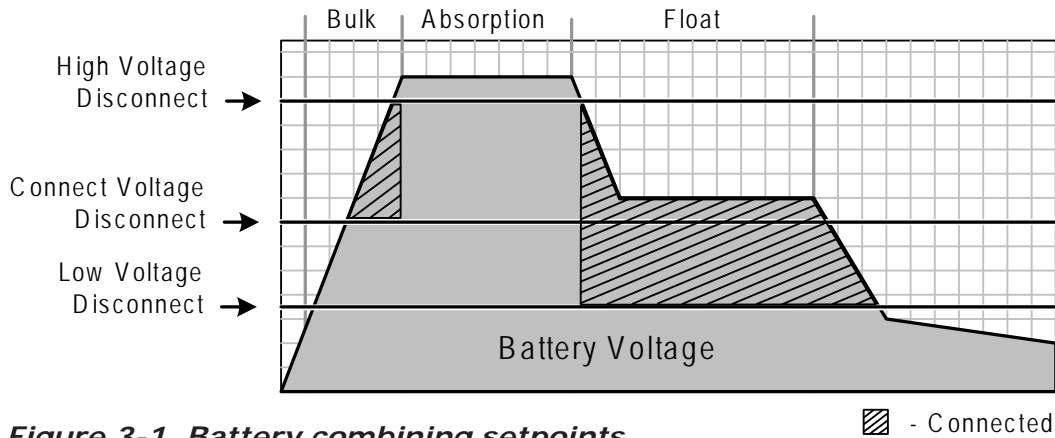


Figure 3-1, Battery combining setpoints

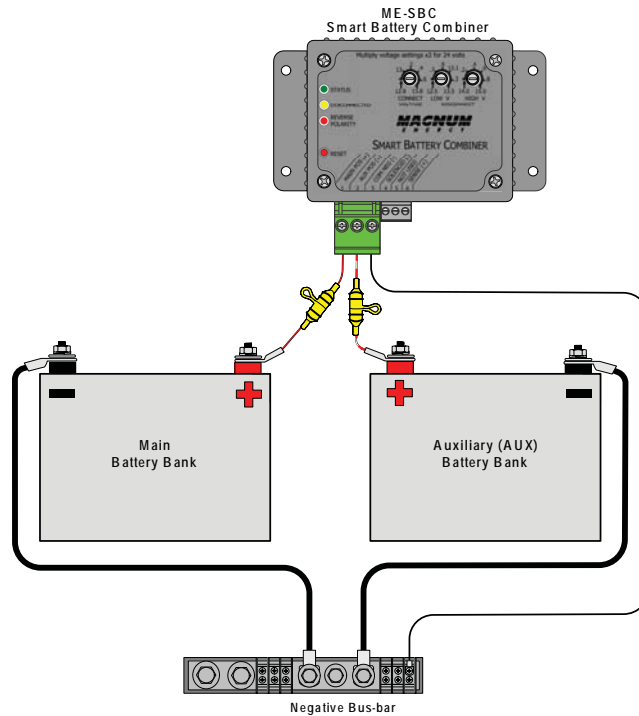
The above diagram represents a typical three-stage charging profile. The first of the three stages is Bulk Charge. This is where up to 80% of the charging is accomplished. During this stage the battery voltage increases significantly and the current that the charging source is providing to the **Main Battery** is at a maximum. The second stage is Absorption, during this stage the battery voltage is held at the Absorption voltage for a period of time. By the end of this process the charge on the battery bank is about 95% complete. The third and final stage is Float. In this stage, the remainder of the charging is accomplished. As long as the **Main Battery** voltage is between the **Low Voltage Disconnect** and the **High Voltage Disconnect**, and the **Main battery** voltage is above the **Connect Voltage**, the ME-SBC™ will pass charging current through to the **Auxiliary Battery**.

The ME-SBC™ combining setpoints as follows:

Connect Voltage: (Settable: 12.8-13.8 VDC) adjusts the point at which the ME-SBC™ passes the charge from the **Main Battery** bank to the **Auxiliary Battery** bank or vice versa. This setting is not active until a charging source is applied to one of the batteries and the voltage begins to increase. Once this setpoint has been reached, the ME-SBC™ will automatically start to pass the charge current through to the other battery. *Default = 12.8 / 25.6 VDC (12V / 24 V system)*

Low Voltage Disconnect: (Settable: 12.5-13.5 VDC) once the charging process has begun and the battery voltage has exceeded the **Connect Voltage** setpoint, the **Low Voltage Disconnect** becomes active. If the voltage begins to decrease, this is the point at which the ME-SBC™ disconnects and stops passing charge current through to the other battery. *Default = 12.5 / 25.0 VDC (12V / 24 V system)*

High Voltage Disconnect: (Settable: 14.0-15.0 VDC) This setting should be used to prevent the ME-SBC™ from passing through too high of a voltage from one battery to other. If this voltage is reached, the ME-SBC™ disconnects the batteries and prevents the high voltage from affecting the other battery. *Default = 14.0 / 28.0 VDC (12V / 24 V system)*



Average Amps	Output Behavior	Status LED
0 - 25 Amps	Full output	Solid steady GREEN
26 - 30 Amps	in dial-back so as to maintain some output. ¹	Slow blink GREEN
>30 Amps	No output	Fast blink RED

Table 3-2, Battery Combining Operation

4.0 Limitations of Throughput

The ME-SBC™ can allow charge currents from either battery to flow through to the other battery (i.e. **Main Battery to Auxiliary Battery** or **Auxiliary Battery to the Main Battery**). When the *MOSFET* turns on inside the ME-SBC™ and the batteries are combined and a significant inrush of current occurs. This inrush may cause the ME-SBC™ to shutdown to protect itself or reduce how much current it actually lets through to the other battery. If the ME-SBC™ shutdown to protect itself, it will restart in 10 Seconds and attempt to recombine. If the ME-SBC™ reduces the output in order to maintain a stable output, it will return to full output as soon as the average amperage through the *MOSFET* lowers to a safe sustainable level.

note 1: When the ME-SBC™ is in the reduced output mode it only lets through about 1/2 of the available amperage. It will continue to operate like this until the total available Amps safely drops to a level the ME-SBC™ can conduct continuously. With a current probe, it may look like 50% of the rated output.

Operation

5.0 LED Indicators

The LEDs on the front of the ME-SBC™ are there to communicate the status of the ME-SBC™, Faults, and Warnings. Use the table below to determine the status of the device.

The **Reverse Polarity** LED indicates that the wiring to the Main Terminal is incorrect. Correct the reverse polarity and the LED should turn off.

ME-SBC™ STATUS and DISCONNECTED LED Indicators		
Status LED (bi-color Red or Green)	Disconnected LED (Yellow)	Description
OFF	OFF	No Power
OFF	ON	Low Voltage Disconnect (LVD). Disconnected
OFF	Slow Blink	High Voltage Disconnect (HVD). Disconnected
Solid Green	OFF	FET switch connects MAIN and AUX connect voltage requirement is met on either battery, connected
Slow Blinking Green	OFF	FET Temp > 80C – goes to 50% duty cycle for charging, connected
Slow Blinking Red	ON	FET Temp > 90C, temperature disconnect . Auto reconnect when FET temperature falls below 70C and if voltage meets "connect" spec. Disconnected
Fast Blink Red	OFF	Average current > 20 Amp. Auto-reconnect after 10 Secs if voltage meets "connect" setting. Disconnected
Solid Red	ON	Average current >30A, current disconnect . Auto reconnect after 10secs when FET temperature falls below 70C and if voltage meets "pull-in" spec. Disconnected

Table 5-1, LED Indicators

6.0 Troubleshooting

Symptom	Solution
Not combining	Check Voltages at the Power Terminal Block . If the Voltage #1 - MAIN POS (+) and #3 - COM NEG (-) or #2 - AUX POS (+) and #3 - COM NEG (-) are above the connect Voltage and the difference between them is less the 10 VDC the ME-SBC™ may be defective. Please call Magnum (425) 353-8833.
No indicators	Check Voltages at the Power Terminal Block . If the Voltage #1 - MAIN POS (+) and #3 - COM NEG (-) or #2 - AUX POS (+) and #3 - COM NEG (-) . The Voltage between 1 and 3 or 1 and 2 must be more than 5VDC.
Not Disconnecting	ME-SBC™ does not disconnect. Remove the fuse at both batteries and check resistance at #1 - MAIN POS (+) and #2 - AUX POS (+) on the ME-SBC™. There should be about 600k Ohms (Ω). If there isn't the ME-SBC™ might be defective. Please call Magnum (425) 353-8833
Auto Reconnecting every 10 Sec	If the Voltage requirements are satisfied and this cycling occurs, then the Current sensing is corrupt or the Current exceeds continuous capabilities. Wait for the charger to go into Float Mode and check status again. If the ME-SBC™ is still toggling it may be defective, otherwise it's probably operating normally and protecting itself.
Adjustments are unresponsive	Turn the knobs fully counterclockwise until they stop and then adjust up to the setting. If they don't stop or don't move call Magnum.

Table 6-1, Troubleshooting table

7.0 Specifications

Sense Module/Meter Specifications	
DC Volts	12 or 24 VDC nominal
DC Amps	25 Amps Continuous;
Maximum VDC	40V peak
Average Operating Tare Loss	~150mW
Maximum Operating Tare Loss	<220mW
Non-operating Tare Loss (on - not combined)	<50mWatts
Operating Range:	0-32 VDC
Shipping Weight:	~2 lbs. (Includes Manual)
Shipping Dimensions	10 x 8 x 3 inches
Unit Dimensions	4.2 x 5.4 x 1.4 inches
Maximum Operating Temperature	-40 to 185F (-40 to 85C)
Maximum Storage Temperature	-40 to 194F (-40 to 90C)
Regulatory	Ignition Protected

Table 7-1, Specifications

8.0 Limited Warranty

Magnum Energy, Inc., warrants the ME-SBC™ battery monitor to be free from defects in material and workmanship that result in product failure during normal usage, according to the following terms and conditions:

1. The limited warranty for this product extends for 12 months from the product's original date of purchase.
2. The limited warranty extends to the original purchaser of the product and is not assignable or transferable to any subsequent purchaser.
3. During the limited warranty period, Magnum Energy will repair, or replace at Magnum Energy's option, any defective parts, or any parts that will not properly operate for their intended use with factory new or rebuilt replacement items if such repair or replacement is needed because of product malfunction or failure during normal usage. The limited warranty does not cover defects in appearance, cosmetic, decorative or structural parts or any non-operative parts. Magnum Energy's limit of liability under the limited warranty shall be the actual cash value of the product at the time the original purchaser returns the product for repair, determined by the price paid by the original purchaser. Magnum Energy shall not be liable for any other losses or damages.
4. Upon request from Magnum Energy, the original purchaser must prove the product's original date of purchase by a dated bill of sale, itemized receipt.
5. The original purchaser shall return the product prepaid to Magnum Energy in Everett, WA. After the completion of service under this limited warranty, Magnum Energy will return the product prepaid to the original purchaser via a Magnum-selected non-expedited surface freight within the contiguous United States and Canada; this excludes Alaska and Hawaii.
6. If Magnum repairs or replaces a product (with either a new or refurbished product), its warranty continues for the remaining portion of the original warranty period or 90 days from the date of the return shipment to the original purchaser, whichever is greater. All replaced products and parts removed from repaired products become the property of Magnum Energy.
7. This limited warranty is voided if:
 - the product has been modified without authorization,
 - the serial number has been altered or removed,
 - the product has been damaged through abuse, neglect, accident, high voltage or corrosion.
 - the product was not installed and operated according to the owner's manual.

BEFORE RETURNING ANY UNIT, CONTACT MAGNUM ENERGY FOR A RETURN MATERIAL AUTHORIZATION (RMA) NUMBER.



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